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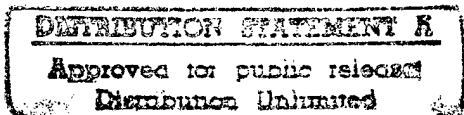
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## **Helicopter Terminal Route guidelines**

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Final Report



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## 1.0 INTRODUCTION

This is the third in a series of three reports that concentrate on existing helicopter route standards and structures, and procedures applied by Federal Aviation Administration (FAA) air traffic facilities. The report focuses on the development, implementation, and maintenance of the FAA's National Helicopter Route Chart Program used in major terminal and en route areas under visual flight rules (VFR), special visual flight rules (SVFR), and instrument flight rules (IFR). It is intended to serve as a guide for air traffic facility managers and the rotorcraft community to assist in administering and managing vertical takeoff and landing (VTOL) route programs. This report is designed to supplement current, in-place FAA national helicopter programs. The basic structure of these guidelines will emphasize strengthening the development, implementation, and maintenance process for integrated rotorcraft route structures through lessons learned from preceding efforts undertaken to enhance operations involving helicopter and fixed-wing aircraft.

### 1.1 OBJECTIVE

The objective of this report is to supplement current, in-place helicopter route procedures and standards. These guidelines are designed to expand upon existing helicopter operational and environmental considerations and assist FAA air traffic facility managers and the helicopter community in route development, implementation, and maintenance. Previous reports (DOT/FAA/RD-90/18, "Rotorcraft Terminal ATC Route Standards" and DOT/FAA/RD-90/19, "Rotorcraft En Route ATC Route Standards") have analyzed helicopter operations in the terminal and en route phases of flight. The recommendations and conclusions from each of these reports form the foundation for a "lessons learned scenario" to enhance the existing Helicopter Route Chart Program.

A three-fold investigative process, consisting of documentation review, operational evaluation, and data collection and analysis, was conducted to ensure that all concerns were appropriately addressed.

### 1.2 BACKGROUND

Helicopters have been active in the National Airspace System (NAS) for more than 40 years. Initial helicopter activities were primarily associated with the military services; however, once the helicopter penetrated the civilian market place, commercial operations steadily increased.

Historically, commercial helicopters operated in visual conditions under either VFR or SVFR. In a nonradar environment, the major factor precluding simultaneous operations of SVFR and IFR aircraft was the inability of air traffic control to provide separation between two aircraft operating in different environments. After the introduction of radar, many facilities were still reluctant to permit SVFR aircraft to operate in a control zone with IFR aircraft. Their rationale for this was that SVFR aircraft were required to remain clear of clouds; consequently, it was impossible to guarantee the aircraft's track, and it was difficult, if not impossible, to ensure the required separation.

When reduced separation minimums were ultimately adopted, many facilities developed their own procedures to optimize these new standards and

ultimately improve their SVFR operations. The result was a dramatic reduction in delays for arriving and departing helicopters. Unfortunately, many of these procedures were discontinued when differing procedural interpretations resulted. Independent access to airports was lost for helicopters and delays again became the norm.

During the early years of helicopter operation, VFR and SVFR flight fulfilled the industry's basic needs and permitted operators to provide the services that their missions required. At that time, most rotary-wing aircraft were ill-equipped to operate in instrument meteorological conditions (IMC). In the past few years, however, operational capabilities of helicopters have improved and their missions have been expanded to the extent that, in many locations, all-weather capability has become a necessity. To meet this demand, helicopters have been equipped with highly sophisticated navigational equipment that permits them to operate in virtually any weather environment. As a result, helicopters have begun to intrude into airspace that had previously been the exclusive domain of fixed-wing aircraft. As this interaction has increased, areas of conflict have begun to develop. Initially, the NAS was not prepared to meet these new demands and IFR helicopters were often considered more of a nuisance than a necessity. In many locations, this discrimination continues today.

During the past 2 decades, aviation has experienced tremendous growth. As a consequence of this virtual explosion of air traffic, many airports have reached saturation. Capacity constraints have resulted in numerous traffic delays, both in the air and on the ground. In order to meet these increased capacity demands, slower aircraft (i.e., helicopters) are separated from the normal flow of traffic and delayed (rerouted or held on the ground) until adequate spacing is available to sequence them into the system.

The FAA has conducted numerous studies of the various factors that have led to the current capacity problems in an attempt to rectify the situation without imposing a penalty on any one class/type of user. The most obvious solution appears to be the construction of new facilities, i.e., new airports, additional runways, and expanded airspace. Fiscal restraints and lack of available land, combined with public resistance, have made it difficult if not impossible to construct new airports and, in many cases, new runways. Although airspace is a constant that obviously cannot be increased, it could be utilized more effectively.

The simplest and most economical approach to increase capacity is to modify existing procedures and/or develop new methods of operation that will provide separate routes to airports and permit both rotary-wing and fixed-wing aircraft equal, but independent, access to landing areas. Each type of aircraft must have access to separate noninterfering routes or corridors to approach and depart the airport.

To ameliorate these problems, FAA Administrator J. Lynn Helms announced, in April 1982, a cooperative venture between the aviation industry and the government to initiate an in-depth review of the existing NAS and the procedures that governed its operation and to subsequently make recommendations for its improvement.

In this undertaking, known as the National Airspace Review (NAR), various groups were tasked to comprehensively review air traffic control procedures, flight regulations, and airspace. Their goals were to validate the current system and to identify near-term changes that would promote greater efficiency and provide the operational framework for future aviation systems.

The specific objectives of the NAR were: (1) to conduct in-depth studies of the airspace and the procedural aspects of the air traffic system, (2) to identify and recommend changes that would promote greater efficiency for all airspace users, (3) to simplify the air traffic control system, and (4) to match airspace and air traffic control procedures with technological advancement and fuel efficiency programs.

During these studies, it was determined that helicopters have not been fully integrated into the air transportation system. Traditionally, helicopters have been forced to: operate in airspace designed for fixed-wing aircraft, conform to standards established for fixed-wing aircraft, and adapt to procedures designed for fixed-wing speeds and maneuverability. These problems have not only created additional workload for the helicopter pilot but also for fixed-wing pilots and air traffic controllers, who have been forced to modify their standard operations to accommodate relatively slow-flying helicopter.

As part of the NAR staff study, the Helicopter Operations Task Group was formed to investigate the need for and/or improvements to helicopter routes. This effort explored the establishment of discrete helicopter routes in and out of major terminal areas which would avoid the standard flow of fixed-wing traffic. After careful analysis of direct routing, the use of very high frequency omnidirectional range (VOR) airways, discrete routing, and terminal control area (TCA) access, the group formulated a number of recommendations related to enhanced TCA access. One of the rudimentary issues centered on the FAA developing non-interfering access/egress to TCAs and controlled airports, and making standardized charting available to the public. To that extent, the FAA has made several changes to various handbooks to satisfy these recommendations. The operating procedures that were developed have been fully implemented and have been very successful. The first charting of these route structures was published on December 17, 1987 for the New York area. Subsequent publishings yielded charts for Washington D.C. in February 1988, Chicago in May 1988, and Los Angeles later in that year. To date, a total of six helicopter route charts have been developed and are vigorously utilized by air traffic control (ATC) and the helicopter community at large.

The needs of the vertical flight community must continue to be addressed if they are to be fully integrated into the NAS. Unique and innovative procedures must continue to evolve and be adopted to ultimately provide helicopters with independent, but equal, access to the NAS. In an effort to support that concept, this document offers recommendations for further changes that will strengthen helicopter route structure development, implementation, and maintenance.

## 2.0 NATIONAL PROGRAM

### 2.1 POLICY

The Helicopter Route Chart Program was officially implemented in January 1990 and is contained in FAA Order 7210.3, Facility Operations and Administration. Its purpose is to enhance helicopter access into, egress from, and operation within high density traffic areas by establishing and charting discrete and/or common use helicopter routes, operating zones, and, where necessary, radio frequencies. The program established a systematic process for chart development, modification, and acquisition, thereby improving operational safety in areas of significant helicopter operations.

Pilot adherence to charted helicopter routes and the recommended altitudes or flight ceilings associated with them is normally voluntary. However, if traffic density and/or safety considerations warrant, or if such procedures are specified in FAA-operator letters of agreement (LOAs), controllers may assign charted routes and altitudes to helicopter pilots and expect or request compliance. If requested by local law enforcement officials, controllers may also restrict operations within designated operating zones if those restrictions don't adversely affect other aircraft operations.

Helicopter route charts are published for each individual location, on a site-specific basis. Normally they are updated on a 2-year cycle, unless revisions are related to safety issues or are necessary to correct significant interference with IFR or other area operations.

### 2.2 DEFINITION

Helicopter route charts are graphic depictions of discrete and/or common use helicopter routes and operating zones that will enhance helicopter pilot access into, egress from, or operation within high density traffic areas. The charts provide altitude or flight ceiling information to facilitate IFR traffic avoidance and pilot adherence to minimum safe altitude requirements. They also include expanded, and in some cases unique, ground reference symbology for visual navigation.

### 2.3 CRITERIA

The Helicopter Route Chart Program stipulates specific criteria to be followed when determining the need for a new or revised helicopter route chart. These criteria are discussed in the following sections.

#### 2.3.1 Routes

The routes that comprise a helicopter route chart are established to avoid primary fixed-wing traffic corridors and are normally derived from existing FAA-operator LOAs. However, these routes may be expanded to permit transitions to, from, and between designated IFR routes and operational heliports, or to enable pilots to circumnavigate designated operating zones if necessary. To the maximum extent possible, charted helicopter routes should reference ground objects that can be readily identified from the air.



### 2.3.2 Operating Zones

Helicopter route charts may be divided into specific operating zones or sectors in which local law enforcement agencies are authorized to conduct exclusive operations when required for official reasons.

### 2.3.3 Altitudes and Flight Ceilings/Floors

Each segment of a helicopter route contains recommended altitudes or flight ceilings/floors that avoid airspace requiring prior authorization or clearance to enter. Controllers should avoid recommending altitudes or flight ceilings/floors that could cause helicopters operating on designated routes to encounter in-flight wake turbulence generated by large, fixed-wing aircraft. When altitude/flight ceiling changes are required, they should be based on a descent rate of 250 to 350 feet per nautical mile.

### 2.3.4 Communications Information

Helicopter route charts contain sufficient radio communications information to permit pilot compliance with pertinent regulatory requirements and to facilitate acquisition and dissemination of traffic advisories.

### 2.3.5 Military Considerations

Established helicopter routes or operating zones should not conflict with military ground control radar approach paths. When charting a route or operating zone which crosses or is located near a military training route, communications instructions should be included to permit pilots to determine the status of the military training route at all times.

## 2.4 RESPONSIBILITIES

### 2.4.1 Helicopter Route Chart Development

Air traffic facility managers are primarily responsible for determining the need for helicopter chart development or revision. Managers who desire to establish a new route chart or revise an existing chart should establish a task force or planning group comprised of personnel from local air traffic offices, General Aviation District Office (GADO)/Flight Standards District Office (FSDO), military aviation units, law enforcement organizations, and helicopter operators to recommend the coverage area for the chart, routes, and operating zones.

Recommendations for new and/or revised charts should be justified, at a minimum, by the following information:

- o background information pertinent to chart development or revision, including composition of task force or planning group;
- o airspace areas and proposed routes, operating zones, and altitude/flight ceiling/floor considerations that were examined;
- o special VFR procedural implications;
- o task force or planning group recommendations; and
- o supporting rationale.

Air traffic facility managers who desire to establish a new chart or revise an existing chart should provide a narrative description or drawing of the chart area, including:

- o identification of all integral routes or operating zones, with named visual checkpoints and elevations, and associated altitude or flight ceiling limitations;
- o IFR routes that fall within the charted area;
- o procedural notes pertinent to operation within the charted area; and
- o traffic advisory radio communications frequencies and ATC facility names associated with area, route, or zone operations.

#### 2.4.2 Chart Approval

Regional air traffic division (ATD) managers are responsible for reviewing and approving new or revised helicopter route charts and assuring that they comply with all prescribed criteria. However, prior to publication and implementation, new or revised charts must be reviewed by ATP-100, Air Traffic Procedures Division and ATP-200, Air Traffic Airspace Rules and Aeronautical Information Division. To accommodate this review time, managers should forward their proposals through ATP-100 to ATP-200 as far in advance of the desired publication/implementation date as possible. The publication lead time required for new charts is approximately 6 to 9 months, and for chart revisions, 3 to 4 months.

#### 2.4.3 Annual Review

Regional ATD managers are responsible for conducting annual reviews of existing helicopter route charts to determine their accuracy and continued applicability.

#### 2.4.4 Chart Revisions

Revisions to existing helicopter route charts may be initiated by any air traffic facility manager, but must be approved by a regional ATD manager. Acceptable justifications for chart revisions include the following:

- o changes, additions, or deletions to area coverage, designated routes or operating zones, controlling agencies and/or frequencies, procedural notes, or airport/heliport status;
- o changes in IFR routes within chart coverage area; and
- o additions or deletions to visual checkpoints.

#### 2.4.5 Publicity

Air traffic facility managers should cooperate with local GADO/FSDO personnel to inform and familiarize local aviation interests about the Helicopter Route Chart Program. Emphasis should be placed on:

- o the voluntary nature of pilot adherence to designated routes, operating zones, altitudes/flight ceilings, and procedural notes;
- o the importance of chart use in achieving operational safety and efficiency, and IFR traffic avoidance; and
- o the "see and avoid" nature of operations within the chart area.

### 3.0 SUPPORTIVE ACTIVITIES

The FAA's National Aviation Policy, which stems from the National Transportation Policy, addresses the development of the nation's air transportation system through the next century. An integral part of that air transportation system is the practical development, implementation, and maintenance of helicopter route structures. Employing helicopter route structures provides effective and efficient utilization of airspace. It also strengthens the overall relationship between shared users of terminal and en route airspace, where vertical flight aircraft must safely operate.

For the most part, the Helicopter Route Chart Program focuses on rotorcraft flight within the visual regime. Unfortunately, flying in visual meteorological conditions (VMC) can be less than ideal. The concept of "clear and a million" can be very misleading and present a false sense of security for the pilot operating in this environment. It seems that the greater the visibility, the greater the chances for pilot or system complacency. The old concept of "see and be seen" is very difficult to apply. Numerous conflicts are built into "see and avoid" airborne traffic scenarios. The overriding purpose of these route charts is to reduce and manage air traffic conflict possibilities in high density traffic situations. By developing a program that constructively manages fluctuations in traffic volume by altitude and direction, a safe and expeditious flow of helicopters can be achieved. This program is an integral part of the FAA's overall aviation safety plan.

The FAA's Rotorcraft Master Plan (RMP) is structured to provide a realistic action plan to foster a successful vertical flight industry that will significantly expand NAS capacity. The RMP envisions a doubling of the demand for vertical flight scheduled passenger service. Furthermore, supplying supportive infrastructure such as published helicopter route charts, advanced aircraft technology, and an adequate supply of trained pilots is identified as a requirement that must be met in order to foster this growth. To meet and fulfill this requirement, certain projects are identified in the RMP:

- o full rotorcraft integration into the NAS, including nationwide IFR and VFR operations, low-altitude operations, and remote area operations, while ensuring that the unique capabilities of rotorcraft are employed to the maximum practical extent;
- o an adequate system of public-use VFR and IFR heliports; and
- o improved safety through upgraded certification criteria and promotion of advanced technology.

These efforts are being actively pursued by the FAA's Vertical Flight Program Office (ARD-30) and associated vertical flight representatives in other FAA offices.

### 3.1 APPROACH AND BENEFITS

One of the focal points in the FAA's overall aviation safety plan is the practical application of helicopter route charts. As stated in paragraph 2.1, the purpose of the Helicopter Route Chart Program is to enhance helicopter access into, egress from, and operation within high density

traffic areas. Employing this type of charting activity allows a more efficient and effective flow of helicopters and fixed-wing aircraft in already confined airspace. A practical plan of action in support of vertical flight has been developed by the FAA's Terminal Procedures Branch (ATP-120) to enhance helicopter chart and route structure development. The need for additional route charts to support the growing vertical flight industry is recognized. ATP-120 understands that further standardization is required so that a formal program mechanism can be developed to guide future charting efforts. The development of this document is part of that initiative. In addition, the anticipated introduction of a civil tiltrotor (CTR) in the future will also necessitate development of a formalized mechanism to accommodate the needs of this type of advanced vertical flight aircraft in the terminal route structure.

The primary purpose of ATP-120's plan of action centers on enhancing rotorcraft operations during both VMC and IMC, and supporting the development of a near-term heliport network. It is foreseen that this effort of charting and route structure development will enhance capacity by improving overall helicopter operational reliability both in the eyes of the public and the community at large as a safe and timely means of transportation. ATP-120 intends to expand existing helicopter route chart coverage to include all high density helicopter traffic areas. In conjunction with this document, they intend to sponsor additional investigative studies and research projects dealing with communications, navigation, and surveillance (CNS) to strengthen vertical flight en route operations and facilitate commercial/scheduled service reliability.

### 3.2 RELATED PROJECTS AND ACCOMPLISHMENTS

There are three key related projects that are dependent on the projected enhancement to helicopter chart and route structure development. Each of these projects has the potential to significantly reinforce and improve chart and route structure capabilities.

- o Transition Routes and Procedures - development of published rotorcraft transition procedures between VFR and IFR routes.
- o Terminal Area Procedures - development of improved procedures for current and future rotorcraft operations in terminal areas.
- o Helicopters and Advanced Rotorcraft ATC Development - research on integration of helicopters and advanced rotorcraft operations into NAS terminal areas, development of simulation models to allow evaluation of ATC procedures.

As each of these projects continue, a primary consideration will be expansion of existing helicopter route coverage to include all high density helicopter traffic areas. In addition, ATP-120 fully expects to have preliminary charts specifically designed to support a planned CTR demonstration during fiscal years 1994 through 1998.

### 3.3 PLANNED ACTIVITIES

The Terminal Procedures Branch has an aggressive schedule in support of vertical flight initiatives. Their current agenda includes the following items:

- o examine new chart coverage area requirements and publish those that are needed to fulfill operational commitments;
- o analyze and examine deficiencies of the Northeast Corridor, recommend enhancements to improve utility and public access to this type of routing system, and determine if this type of system can be employed in other high density air traffic regions;
- o study the feasibility of limited and discrete IFR helicopter route structures in selected regional areas; and
- o establish an air traffic point of contact in every region to handle helicopter activities.

#### 4.0 HELICOPTER ROUTE STRATEGY

The fundamental strategy behind developing these guidelines is to offer a working document for air traffic facility managers and the helicopter community to facilitate development, implementation, and maintenance of integrated helicopter route structures and procedures. This document is designed to serve as a supplement to current, in-place FAA national programs, as defined in section 2.0. It provides a logical organization of material to strengthen and reinforce the development, implementation, and maintenance process necessary to integrate helicopter route structures into the overall ATC system. This document also furnishes recommendations to augment established criteria for route structure management based on previous work.

#### 4.1 DEVELOPMENT

The primary task in helicopter route structure administration is the chart development process. That process must highlight and incorporate the various concerns of helicopter route operators, users, controllers, and maintainers to ensure each concern is appropriately addressed. The following paragraphs describe areas that can facilitate and enhance helicopter route chart development.

##### 4.1.1 Task Force/Working Group

When the need for a new helicopter route chart has been determined by the appropriate air traffic facility manager, a task force or working group should be established to recommend the basic coverage area and to develop appropriate routings, structures, operating zones, procedures, and other information which will be included in the new chart. Members of the task force should represent a broad spectrum of affected individuals and organizations to ensure a comprehensive and coordinated effort. Membership should focus on including specific government representatives that manage the air traffic and airport assets in addition to representation from the service and operational organizations that support helicopter activities. Memberships will vary depending on the needs of the community. The following is a typical membership listing:

- o Local Air Traffic Organizations/Facilities,
- o Designated Air Traffic Helicopter Coordinator,
- o Local GADO/FSDO,
- o Regional Air Traffic Representative,
- o Regional Heliport Coordinator,
- o ATP-220 Cartographic Standards Branch,
- o ARD-30 Vertical Flight Program Office,
- o National Oceanic and Atmospheric Administration,
- o National Oceanic Service,
- o Commercial Regional Helicopter Operators,
- o Helicopter Service Organizations,
- o Law Enforcement Agencies,
- o Emergency Medical Service (EMS) Operators,
- o Military Operators,
- o Local Fixed-Base Operators, and
- o Helicopter Societies and/or Associations.

By including representation from all of these areas, consensus can be achieved regarding the true needs of the helicopter and air traffic communities and how to best meet those needs through development of an approved helicopter route chart.

#### 4.1.2 Community Involvement

Recognition of vertical flight as a viable transportation mode by urban transportation planners is critical. Although technical expertise is paramount in establishing aviation system requirements such as helicopter routes, a more community-oriented, interdisciplinary, and technology-driven planning approach than previously employed is required to increase system effectiveness and community involvement. The majority of communities do not yet see the benefits of vertical flight aircraft or even their connection to intermodal or an overall national transportation system. If vertical flight is to survive as a significant part of the national transportation infrastructure, it must become a community consideration, not just an aviation concern. Active participation by community leaders in the development stage is necessary to ensure local municipalities' concerns are addressed.

#### 4.1.3 Safety and Noise

The FAA's prime concern when implementing a new system or part of a system is the safety of the aviation user. A secondary, yet important, concern is the environmental effects of the system for the users and general public. If a system is not acceptable to the majority of people affected by it, it will not be utilized fully and will not be cost-effective. These general guidelines apply to development of a helicopter route chart. When instituting new routes and procedures specifically for helicopters in congested areas, the safety of the operators must always be the overriding concern. Additionally, the noise impact of helicopters using these special routes must be considered when siting the routes, selecting altitudes, and plotting chart coverage. The success of the helicopter route chart program may largely be determined by its acceptability to the population located in the coverage area, not just users of the system.

Preparatory efforts during previous chart development have found that route placement is the driving factor from both a safety and environmental standpoint. Investigative research of current helicopter route charts offers an established methodology to support route placement. The leading consideration stresses placing routes over selected major roadways, prominent waterways, and along designed shorelines, if available. This practice should be continued as an essential starting point. In most cases, this action significantly reduces the safety and noise impacts on residential communities near designated routes. It also provides the pilot a reasonable course of action to assess open areas for emergency landings, which is a chief concern of pilots, operators, and the public.

#### 4.1.4 Traffic Flow/Density

In addition to the safety and noise concerns of the community, air traffic control must examine the existing traffic flow patterns for

VFR/IFR helicopter and fixed-wing air traffic. The introduction of new routes that have different traffic flow patterns can have an adverse effect on how air traffic is handled. All efforts must be directed toward providing a helicopter route structure that doesn't interfere with existing operational patterns.

Traffic density is another issue that must be considered, i.e., what volume of helicopter traffic is required to warrant development of a route chart. Current directives do not furnish any specific guidance with the exception of stating "air traffic facility managers are responsible for determining the need for a chart." For the most part, this is a good starting point; however, the investigative aspects of this issue must go well beyond the facility manager. Review of the following areas can assist in making this determination:

- o review monthly traffic count logs,
- o analyze associated delays for VFR and IFR traffic,
- o assess complaints about quality of service provided,
- o attend local meetings for helicopter and fixed-wing associations or societies,
- o survey associated letters of agreements that support local operators, and
- o examine requests for modified procedures within terminal areas.

#### 4.1.5 Helicopter and Fixed-Wing Conflicts

As previously stated, one of the prime reasons for establishing helicopter routes is to create access and egress to controlled airspace for helicopters that does not interfere with other VFR/IFR traffic. Part of the route development process must include analyzing existing and projected traffic flow patterns. By overlaying each pattern, potential points of conflict can be identified and appropriately addressed. An in-depth examination must be performed to ensure that any modification to route patterns does not inadvertently affect other patterns. This phase is extremely difficult to accomplish, because cause-and-effect outcomes are not always clearly evident.

A potential built-in conflict area exists in the vicinity of arrival and departure corridors to most airports. The majority of these corridors encompass a considerable amount of controlled airspace and have been developed over time to ensure safety and environmental concerns are satisfied, in addition to ATC priorities. These areas are probably the most difficult to evaluate, since each aircrew or pilot feels a certain priority should be assigned to his/her operation. Safety will always be the overriding factor in any examination of potential conflict points.

#### 4.1.6 Altitudes

In general, selected route altitudes should: provide adequate obstacle clearance, provide separation from underlying noise-sensitive areas, and not conflict with airport arrival and departure corridors. Where route segments have mandatory altitudes, these segments must be flight-inspected to ensure that appropriate obstacle/terrain clearance exists. In addition, an obstacle evaluation program should be implemented to afford protection from future construction initiatives. Specific



consideration must be given to air-ground communication frequency reception. Designated route altitudes must ensure that acceptable levels of communications coverage exist for each segment of the route structure.

#### 4.1.7 Check/Reporting Points

Check points should be prominent features easily identified from the air during all weather conditions throughout the year. It is often difficult to satisfy this requirement, but poor examples would include ponds that dry up during the summer or islands that disappear during varying tide conditions.

When compulsory reporting points are depicted, the controlling ATC facility to receive the report should be indicated. If the purpose of the reporting point is to self-announce a position for the benefit of other operators, this should also be noted.

#### 4.1.8 Size of Chart

The chart size should be small enough to be easily managed in helicopters flown by a crew of one and large enough so that it may be read with clarity. If practical, the helicopter route chart should be printed on the reverse of the TCA chart where applicable. This would reduce the number of charts that a pilot is required to carry, in addition to providing supplementary navigational information about the operational area.

#### 4.1.9 Chart Graphics and Detailing

As helicopter route charts have evolved, their graphics and symbology have become more standardized. As an example, the depiction of check/reporting points such as buildings appears on the chart as miniature facsimiles closely resembling not only the appearance of the facility, but its placement as well. This technique offers pilots a first-hand picture of what to expect while navigating a route. This type of innovation has enhanced the usability of helicopter charts and should remain in effect for all such charts.

The detailing or contrasting of ground objects and terrain should be accomplished in order of importance to the user. In reviewing the Baltimore-Washington Helicopter Route Chart, the significance of visually identifying railroad tracks is important for establishing position or bearing. Accordingly, the railroad tracks are detailed in a bolded fashion to stand out. On the other hand, railroad tracks are readily visible from the air and do not represent a hazard to navigation. High-tension towers and cables, however do represent a substantial hazard, but are shown with less contrast than railroad tracks. This is a potential area where modification or improvement to the chart might be warranted.

As improvements or modifications are recognized, they should be brought to the attention of ATP-220, the FAA's Cartographic Standards Branch, who is responsible for aviation map and chart standards.

#### 4.1.10 Frequencies and Transponder Codes

Designated frequencies and transponder codes should be assigned to handle the helicopter traffic operating within the helicopter route structure. Having separate route frequencies will reduce the overall frequency congestion between routes designated for VFR and IFR traffic. In addition, using discrete transponder codes provides a positive means of monitoring air traffic operating along various segments of the route. Predetermined codes could also be used to identify special-use operations such as law enforcement and EMS activities.

#### 4.1.11 Letters of Agreement

The basic foundation for development of a helicopter route chart should exist within current LOAs. For the most part, these agreements document a systematic method in which operators and controllers presently handle helicopter traffic in a terminal environment. The development of a specific helicopter route chart should for the most part transfer the written text of an LOA to a pictorial illustration. ATC facilities should be able to consolidate their LOA files based on publication of a helicopter route chart. This does not remove the necessity for an LOA to support unique or special requirements. The controlling facility may be able to merge these requirements under similar headings, i.e., law enforcement, military, or EMS.

### 4.2 IMPLEMENTATION

The method by which a helicopter route chart is implemented is just as critical as its development. The development of modified routes and procedures must be effectively governed and efficiently activated. The following paragraphs offer expanded direction for implementing helicopter route charts.

#### 4.2.1 Incremental Review

During implementation, a helicopter route chart should be reviewed as an iterative process at various stages of the implementation effort. This allows specific problems that may arise to be identified more easily and quickly, since the implementation phase will be reviewed several times during the process and not just at the end. This review should include individuals who were part of the task force/working group, users in general, and even concerned members of the community who are affected by helicopter operations in the charted area.

#### 4.2.2 Publication

The publication lead time for a helicopter route chart, as specified by ATP-220, should be 6 to 9 months for a new chart. This time does not take into account the development phase. Sufficient planning and lead time must be built in to satisfy current printing cycles. However, to assure completion of all requisite FAA review and publication requirements, additional time tolerances may be required on a case-by-case basis. Close coordination should be maintained between the responsible ATC facility manager and ATP-100/200.

#### 4.2.3 User/Operator/Controller Commentary

In conjunction with the initial distribution of a new helicopter route chart, the task force/working group should convene within approximately 3 months after the chart has been introduced. An open forum should be conducted to solicit comments from users, operators, and controllers outside the task force/working group to determine whether any operational changes or modifications to the chart are needed.

#### 4.3 MAINTENANCE

The chief concern after a particular helicopter route chart has been in use is its maintenance on a continuing basis. The state of maintenance can have a greater impact on its potential use than either of the other two stages if updates and revisions do not accurately reflect user and operator concerns. Does the chart appropriately satisfy the operational issues? What should be done to enhance or improve its capabilities? How are user and operator suggestions handled and addressed during the review process? Primary responsibility for the process of maintaining a helicopter route chart centers around the task force/working group. As a footnote, the current publication lead time for minor revisions to published helicopter route charts is approximately 3 to 4 months to match current printing cycles. The following paragraphs offer additional clarification on the chart maintenance process.

##### 4.3.1 User Commentary

Just as user input and commentary is crucial during development of a helicopter route chart in order to establish a service that is valuable to the users, it is also imperative that such input be considered as part of the maintenance phase to assure that chart application occurs in a manner that is of maximum benefit. Inputs should be solicited from a cross-section of users through designated points-of-contact within various user organizations and presented to the task force/working group as part of its scheduled meeting agenda.

##### 4.3.2 Task Force/Working Group Review

Once a helicopter chart is developed and implemented, it must be updated with regularity in order to remain compatible with current operations. The task force/working group that plays a large part in developing the chart must also continue to review and modify it as necessary. Under the current program, facility managers are charged with annually reviewing existing helicopter charts to determine their accuracy and continued applicability. This requirement should be extended to include annual review by the task force/working group. Members of the task force should solicit inputs from experts that they represent and bring them to task force meetings for resolution. Likely changes to maintain charts in an updated status could include:

- o changes, additions, or deletions to area coverage, designated routes or operating zones, controlling agencies and/or frequencies, procedural notes, or airport/heliport status;
- o changes in IFR routes within chart coverage area; and
- o additions or deletions to visual checkpoints.

#### 4.3.3 Community Acceptance

Transportation is an integral component in the infrastructure of every city. Helicopters are becoming a vital component of urban transportation due to their ability to increase the efficiency of transportation for a growing sector of the public. Heliports and vertical flight aircraft can be effectively integrated into both aviation and intermodal transportation systems when their operation and applications are understood. This calls for better, more precise comprehension of the needs for expanded use of vertical flight in current planning requirements.

Helicopters add a critical dynamic to urban transportation because heliports and vertical flight technology have the potential to bring aircraft right into existing communities. However, this aspect of vertical flight can also introduce concerns of noise and safety. If vertical flight is to be an effective contributor to the urban transportation infrastructure, it must become a community consideration, not just an aviation concern. Heliport planning and development concerns dealing with safety are closely correlated to public perception and community acceptance.

Developing specific routes for vertical flight aircraft is a major step in allaying public concerns. Helicopter routes can provide pathways to lead aircraft away from noise-sensitive and populated areas where concerns are most prevalent.

Helicopter routes must be developed through cooperation and participation of air traffic control, helicopter operators, and sections of the community that will be affected by noise along proposed routes. When establishing and maintaining routes, the major considerations should be:

- o land use along the proposed route,
- o location of heliports,
- o approach and departure paths,
- o safety and emergency preparedness,
- o intensity of operations,
- o number and type of operations,
- o mix of helicopter types, and
- o levels of ambient noise.

Route maintenance evaluations by concerned sections of the community should be implemented at regular intervals to make reasonable modifications to routes in order to accommodate and continue rotorcraft/community compatibility.

##### 4.3.3.1 Reach-Out Programs

To enhance community acceptance, local operators need to develop a reach-out program that introduces their helicopter activities to the local citizenry. As an example, "fly neighborly" programs have been developed and employed in many communities throughout the United States. Their primary emphasis is noise reduction through voluntary participation by civil, military, and government helicopter operators. The Helicopter Association International (HAI) has developed a very successful program.

HAI addresses noise abatement and public acceptance objectives with activities in the following areas:

- o pilot and operator awareness,
- o pilot training and indoctrination,
- o flight operations planning,
- o public acceptance and safety, and
- o sensitivity to concerns of the community.

As an extension of developing and maintaining a supportable helicopter route structure, this type of program must be at the forefront to ensure compatibility with community concerns.

#### 4.3.3.2 Community Meeting/Forum

To further strengthen community acceptance, in addition to task force/working group review to maintain helicopter route charts accurately, some type of community or public input should be solicited on a regular basis to ascertain the effect that the program is having on the community at large. Questions of safety, invasion of privacy, or noise may surface in such a forum that would not be addressed by members of the task force. Public concerns can play a large part in overall success or failure of the Helicopter Route Chart Program. Consequently, it is in the best interests of the FAA and the helicopter community to address and resolve public concerns on an ongoing basis in order to promote acceptance of this program and vertical flight operations in general.

## 5.0 FUTURE CONCEPTS

The FAA has conducted numerous studies of the factors that have created today's aviation problems. One often heard solution is the presumption that more is better, i.e., more heliports, more runways, more airplanes or helicopters, and additional airspace. Fiscal restraints and lack of available land assets, combined with public resistance, have made it difficult if not impossible to find a solution. Adding more aircraft to the current system would not improve conditions, merely exacerbate them, since congestion would be increased with no gain in capacity. Airspace is a constant that obviously cannot be increased, although it could be utilized more effectively.

The alternative, then, becomes the need to do more within existing parameters, to modify and improve current procedures and/or develop new methods of operation that will provide routes to permit helicopters and fixed-wing aircraft equal but independent access to landing areas.

Presently, helicopter operations constitute a very small percentage of total operations within the NAS. If vertical flight aircraft are to be permitted to assist in solving some of these transportation problems, they must have access to separate noninterfering routes or corridors to approach and depart their landing areas.

As a result of this and previous research and development (R&D) efforts performed by SCT that focused on analysis of ATC standards and procedures, following future concepts are offered.

### 5.1 HELICOPTER VISUAL APPROACH PROGRAM (HVAP)

As a result of previous reports "Rotorcraft Terminal ATC Route Standards," (DOT/FAA/RD-90/18) and "Rotorcraft En Route ATC Route Standards," (DOT/FAA/RD-90/19) the development of an independent visual approach program for rotorcraft, similar to the charted visual flight procedures (CVFP) currently in use should be investigated for high volume airports to enhance safety through operational effectiveness. This program would provide criteria for developing helicopter visual approach procedures specifically at those locations experiencing excessive airport traffic delays for fixed-wing and helicopters. These helicopter visual approach procedures could provide SVFR entrance to an airport whose approaches are restricted because of IMC without conflicting with the IFR traffic flow. At those airports, when it has been determined by the responsible ATC facility manager that an HVAP is required, action may be initiated to develop the required procedures. HVAPs should be developed by ATC in accordance with the following:

- o determine that the use of an HVAP will not cause an operational hardship on the control facility or users of the ATC system,
- o design procedures to minimize fuel use and flight time,
- o ensure that visual arrival routes and altitudes are in accordance with established procedures and are compatible with ATC operational requirements,
- o coordinate proposed procedures with the responsible FSDO to ensure that new or revised procedures are compatible with aircraft flight characteristics, and

- o submit proposed HVAPs for review to the Regional ATDs to ensure compatibility with designated program criteria.

#### 5.1.1 HVAP Criteria

The following minimum criteria should be employed in undertaking this program. This does not preclude individual facilities from adjusting or modifying their independent programs to satisfy unique operational requirements. This is a minimum list designed to ensure safety is not compromised.

- o Radar control is required.
- o An operating tower is required at an airport served by an HVAP.
- o HVAPs shall be developed to a specific helipad.
- o HVAPs shall originate at or near, and be designed around, prominent visual landmarks. When a determination is made that a landmark cannot be readily identified at night, the procedure shall be annotated "Procedure Not Authorized at Night."
- o HVAPs normally should not extend beyond 5 miles from the landing area.
- o Electronic navaids should be used as supplementary information only.
- o Course information between landmarks along the proposed flight path may be provided for general orientation.
- o Minimum altitudes may be established for obstruction clearance. Recommended altitudes may be established for noise abatement purposes.
- o Establish weather minimums for the procedure as follows:
  - ceiling of at least 500 feet,
  - visibility of at least 1 mile,
  - greater ceiling/visibility values may be required if determined necessary for safe accomplishment of the procedure, and
  - published ceiling and visibility values must be reported at the airport/heliport for authorized use of the procedure.
- o Missed approach procedures will not be published.
- o HVAPs shall be named for the primary landmark utilized during the approach, i.e., Bolling Visual, Glebe Visual, etc.

#### 5.1.2 HVAP Guidelines

The development and implementation of an HVAP will provide efficient use of restricted and confined airspace assets in the vicinity of high volume airports. The following guidelines have been formulated to streamline HVAP operational effectiveness.

- o Changes in arrival routes which routinely route traffic over noise-sensitive areas may require an environmental assessment and impact statement or finding of no significant impact, as defined in Order 1050.1C, Policies and Procedures for Considering Environmental Impacts.
- o Chart format and symbology shall be in accordance with criteria established by ATO-200, consistent with applicable charting policies.
- o Regions shall ensure that procedures are contained within controlled airspace and the TCA, if one exists.
- o Facility managers shall document new and/or revised HVAPs for each helicopter visual approach on a separate FAA Form 7110.XX and forward to the regional ATD.
- o After ATC approval of a procedure by the ATD manager, the region will process the HVAP through the Flight Standards Flight Inspection and Procedures Staff to the appropriate Flight Inspector Field Office (FIFO). The FIFO will determine flyability and process the HVAP through the same channels used for instrument approach procedures.

#### 5.1.3 Examples of Potential Helicopter Visual Approaches to Washington National Airport

Referenced routes are depicted on the Washington area helicopter route chart (see figure 1).

#### 5.1.4 Glebe Approach (Helicopter Visual)

An example of a helicopter visual approach called the Glebe Approach is shown in figure 2. Transition visually to the final approach course via Helicopter Route 5, at or below 1,300/800 feet mean sea level (MSL). Descend eastbound along South Glebe Road/Four Mile Run. Remain at or above 200 feet until passing the railroad yard, then direct to landing at the west helipad. Do not cross the railroad yard if landing traffic is not in sight.

SPRINGFIELD TRANSITION - Helicopter Route 5: from the south - Springfield, via I-395 to Glebe Road/Route 7 intersection, at or below 1300 feet MSL; and from the north - Pentagon/Navy Annex via I-395 to Glebe Road/Route 7 intersection, at or below 800 feet MSL. Helicopter Route 7: from the west - via Route 7 to Glebe Road.

LANDING AREA: West helipad - southwest corner of airport. (West end of taxiway A, western edge of general aviation parking ramp.)

#### 5.1.5 Bolling Approach (Helicopter Visual)

An example of a helicopter visual approach called the Bolling Approach is shown in figure 3.





FIGURE 1 WASHINGTON DC HELICOPTER ROUTE CHART EXCERPT - NATIONAL AIRPORT TCA

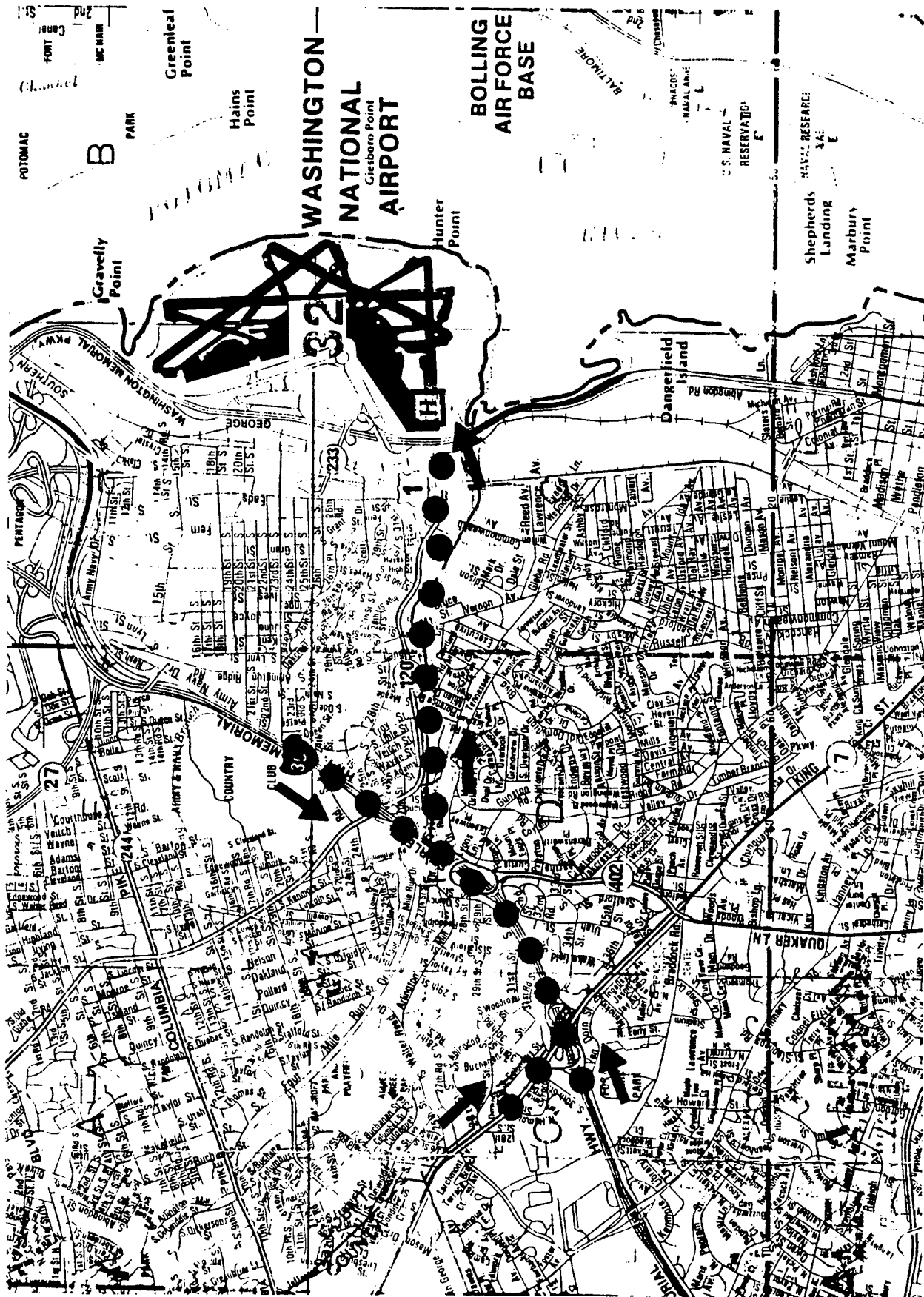


FIGURE 2 GLEBE APPROACH (HELICOPTER VISUAL)

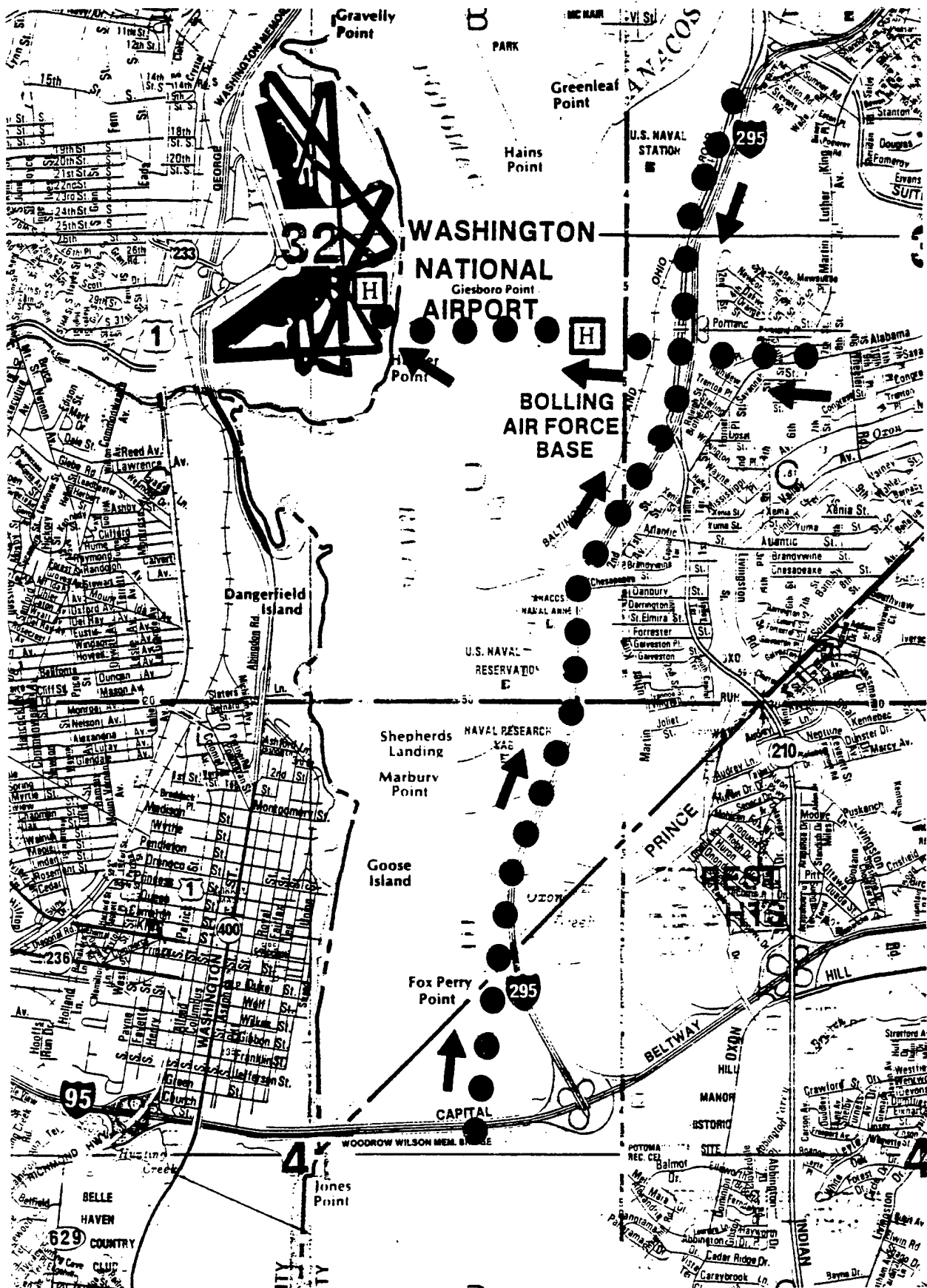


FIGURE 3 BOLLING APPROACH (HELICOPTER VISUAL)

Transition visually to the final approach course via Helicopter Route 6 or I-295 at or below 500 feet MSL. Descend westbound visually over Bolling Heliport, direct to National Airport east helipad. Remain at or above 200 feet until crossing the eastern shoreline of the Potomac River. Do not cross the shoreline if landing traffic is not in sight.

WILSON TRANSITION - Interstate 295: from the south - Wilson Bridge, via I-295 to Bolling Air Force Base main gate/Portland Street, at or below 500 feet above ground level (AGL); from the north - Douglas Bridge, via I-295 to Bolling AFB main gate/Portland Street, at or below 500 feet AGL. Helicopter Route 6: from the east - via Route 6 from Andrews AFB to Bolling AFB.

LANDING AREA - East Helipad located on shoreline midway between approach end of runway 33 and approach end of runway 21.

## 5.2 HELICOPTER ROUTE CHART IMPROVEMENTS

Based on a two-fold investigative study (DOT/FAA/RD-90/18, "Rotorcraft Terminal ATC Route Standards" and DOT/FAA/RD-90/19, "Rotorcraft En Route ATC Route Standards") of specific ATC environments, information was compiled on helicopter route charts. Individuals in areas where there are no officially sanctioned charts are divided in their opinions as to value and necessity. In areas where helicopter routes have been published, operators and controllers generally have nothing but praise for their usefulness and convenience. These charts have notably streamlined controllability and refined the quality of ATC service provided, not to mention reducing the number of LOAs required by ATC facilities to control terminal air traffic. As part of these investigative studies, the following recommendations were received regarding helicopter route charts.

- o Standardize the notes that are printed on the charts or separately identify those notes that mandate action from notes that merely provide information.
- o Establish hospital-to-hospital routes for EMS operations. The majority of EMS operations involve this type of activity. Establish other EMS routes as required by local conditions and operations.
- o Overlay helicopter routes on the TCA chart. The routes could be depicted by a series of helicopters placed along the routes so that other pilots would be aware of helicopter activity.
- o Print mandatory altitudes in a contrasting color for emphasis.
- o Annotate dedicated helicopter frequencies on TCA charts and instrument approach procedure charts. Currently, they are only depicted on helicopter route charts and fixed-wing pilots are unaware of helicopter activities.

### 5.3 POINT-IN-SPACE APPROACH

If rotorcraft are to gain equal access to airports without interfering with the fixed-wing traffic flow, innovative approach procedures must be developed and adopted. VFR and SVFR flight environments appear to provide the best solution to this access problem, but the difficulty of transitioning from an instrument to a visual environment continues to pose a significant problem. The concept of a point-in-space approach, if properly developed, seems to offer the simplest and most logical method of providing this transition and ultimately permitting rotorcraft to help relieve delay problems.

A point-in-space approach, if properly designed, can assist rotorcraft in transitioning from an IFR route to a visual route and could provide the latitude for tailoring airspace to fit the needs of both fixed-wing and helicopters with a minimum of expense.

Today's operating procedures require the use of a published instrument approach to make the IFR to VFR transition. This forces both fast and slow aircraft to be funnelled into a single approach path, leading to a slowdown of traffic and delays. The end result is saturation of approach control airspace.

FAA Order 8260.3B, chapter 11, Helicopter Procedures, authorizes development of a point-in-space approach at locations where the center of the landing area is not within 2,600 feet of the missed approach point, and explains that the intent of the approach is to provide rotorcraft with a means to transition from an instrument environment to one of visual flight.

The following recommendations are provided to encourage the development and use of point-in-space approach procedures.

- o Design/develop point-in-space approach procedures that terminate at, or close to, a prominent landmark, i.e., highway interchange, bridge, toll plaza, etc. The landmarks would permit pilots to orient themselves once clear of clouds. The termination point of the approach could serve a dual purpose, since it could also be an access point to a route depicted on a local helicopter route chart.
- o Investigate the feasibility of using a system of lights, similar to lead-in lights, at the termination point of the approach that would provide a "route direction arrow" to indicate the next desired track. More than one arrow could be used in the event several routes radiate from the same point.
- o Change the publication standard for point-in-space procedures to depict the landmark (termination point or missed approach point (MAP)) in the space presently reserved for a sketch of the airport/heliport.
- o Investigate the possibility of amending existing rules and/or procedures to mandate cancellation of an IFR flight plan once a rotorcraft completes a point-in-space approach and the pilot does

not execute the appropriate missed approach procedure. This is especially important if the pilot is entering uncontrolled airspace.

#### 5.4 STANDARD INSTRUMENT DEPARTURE (SID)/STANDARD TERMINAL ARRIVAL ROUTE (STAR)

STARs provide pilots with the ability to transition between an outer fix or arrival waypoint in the en route structure to the terminal area and the airport. Conversely, SIDs depict routes from the airport through the terminal area to the en route structure. They permit pilots to perform their own navigation while reducing controller workload.

Conflict between helicopters and fixed-wing aircraft normally occurs in terminal airspace where a mix of fast and slow aircraft must be sequenced in a logical order before landing or after takeoff. When aircraft are of the same type, or capable of flying at similar airspeeds, these predetermined routes provide assistance to the controller by removing the need to provide numerous radar vectors in order to establish the appropriate sequence. In-trail spacing becomes extremely time-consuming and often difficult when the traffic is comprised of both turbine-powered, fixed-wing aircraft with a normal speed of 210 to 240 knots and aircraft that are only capable of a 100- to 150-knot speed range. Consequently, the slower aircraft are often rerouted to simplify the operation.

A helicopter STAR should be developed that originates at a feeder fix in the en route environment and incorporates appropriate navigational guidance (VOR/distance measuring equipment (DME), global positioning system (GPS), and/or long-range navigation (LORAN-C)) that provides routing to a final approach fix for an independent approach to the airport. Alternatively, the routing could lead to an approach fix for a point-in-space approach. The approach would terminate in visual conditions at the edge of the airport traffic area or provide entry to the VFR route structure.

In busy terminal areas, dedicated helicopter SIDs are needed to segregate departing rotorcraft from the standard departure routes of fixed-wing aircraft. They should originate at the heliport/helipad and not from the end of a runway. Initial routing should be perpendicular to the flow of arriving traffic and well clear of the fixed-wing departure stream. At lower activity airports, exclusive rotorcraft SIDs and STARs may not be necessary unless there are significant rotary-wing/fixed-wing traffic conflicts.

The following recommendations are provided to assist in STAR/SID development.

- o Publish a new generation of SIDs and STARs designed for rotorcraft that will provide separate, independent routing to and from the airport.
- o At busy airports, the SID should be designed to commence at the heliport/helipad and not at the end of a runway. Initial routing should be perpendicular to the flow of arriving traffic and well

clear of the fixed-wing departure stream. At lower activity airports, this may not be necessary if there are no significant rotary-wing/fixed-wing traffic conflicts.

- o The STAR should incorporate VOR/DME, area navigation (RNAV), and LORAN-C tracks that provide routing to a final approach fix for an independent approach to the airport. Alternatively, the routing could lead to a fix that could: (1) provide access to a point-in-space approach that would terminate in visual conditions outside the airport traffic area, and (2) provide subsequent entry to a VFR/SVFR route to the airport.

## 5.5 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

The possibility of utilizing TCAS to assist in obstruction avoidance at extremely low flight altitudes should be investigated. It might be feasible to require installation of a TCAS transponder on some hard-to-see obstructions, especially obstructions that are located in heavily travelled rotary-wing corridors. The TCAS transponder would indicate the obstruction as traffic, and the pilot could then take appropriate steps to avoid it. Chart graphics could be developed to depict the transponder-equipped obstruction on the route chart.

## 5.6 ANALYSIS OF ATC SUPPORT FUNCTIONS

Discussions with both helicopter operators and air traffic controllers during previous studies failed to uncover any significant restraints that preclude helicopters from proceeding virtually unrestricted during the en route phase of flight. However, since many helicopter operations are performed at very low operating altitudes and from off-airport locations, such as heliports, they often generate requirements for ATC services in areas not normally used by fixed-wing aircraft. The following paragraphs address these requirements from a conceptual innovation standpoint. Each section presents a proposal to deal with communication, navigation, surveillance, weather, and facility control positions.

### 5.6.1 Communications

Communications frequency congestion in virtually any major metropolitan area creates constant concern for the safety of operations. The inability to communicate results in excessive time delays, undue frustration, inefficient and/or inadequate transfer of required information, and unnecessary risk on the part of many operators. An acute awareness of the problem and pilot/controller diligence have thus far averted accidents. With an ever-increasing number of operators, however, the situation only worsens. In some areas, the problem revolves not only around congestion but, to an even greater degree, controller workload.

At many busy locations, especially during heavy fixed-wing traffic periods, helicopters are controlled from an operating position that is dedicated exclusively to the control of helicopters on a discrete frequency. When a discrete frequency is utilized, it normally encompasses airspace that underlies or is included in some other airspace block and serves two purposes: first, it enables air traffic personnel

to control the helicopters, and secondly, it enables the helicopter pilot to monitor reports from other helicopters operating along the same routes. This extra benefit provides additional traffic information to the pilot and further enhances the safety of the VFR system. However, it is normally not germane to en route and/or instrument operations, where all aircraft within a given sector communicate with the controlling facility on the same frequency.

Operators surveyed were not aware of any other significant communications problems in their primary operating areas; however, they reported some communications difficulties in tower en route airspace, especially at minimum en route altitudes (MEA). Although they rarely had difficulty hearing tower transmissions, it was not uncommon for the tower to have problems hearing transmissions from helicopters, especially in the outer fringes of their airspace. It could not be determined whether this was a problem with aircraft transmitters or the result of the low altitudes used by helicopters. It does, however, indicate that there is a need for additional remote communications facilities (RCFs). These RCFs should be located in the vicinity of normal communications transfer points throughout the tower en route control (TEC) system.

#### 5.6.2 Navigation

##### 5.6.2.1 Long Range Navigation (LORAN-C)

Navigational capabilities have been greatly enhanced for helicopters with the introduction of LORAN-C, providing pilots with both IFR and VFR capabilities. Because they operate for the most part VFR, helicopter pilots using LORAN-C RNAV have greatly increased navigational efficiency by improving their ability to map-read while maintaining proper visual vigilance. No LORAN-C receivers are certified for an approach function. Operators will incur a recertification cost to upgrade their airborne avionics.

As LORAN-C instrument approach capabilities become available, heliports will be able to have instrument approaches without the added cost of equipment and the need to provide space for a ground-based navigational aid. Currently, the only LORAN-C, off-airport, public-use approach in use has been implemented at Venice, Louisiana.

##### 5.6.2.2 Global Positioning System (GPS)

GPS must be viewed as a long-range solution for helicopter navigation. This conclusion is based on: (1) current development status of the system, (2) unresolved system integrity issues, (3) unknown reliability capabilities, and (4) yet-to-be-determined access to the full capabilities of GPS by civil users.

Although GPS offers promising navigational possibilities based on recent reports by RTCA and others, the system is in its infancy and will require an extended test and evaluation period prior to certification and approval for use in the NAS. It may eventually provide additional en route navigation opportunities for rotorcraft. It may also provide pilots with nonprecision approach capability to virtually any location in the world. Proponents believe that enhanced GPS, either in the form



of differential GPS or access to all the capabilities of the military system, may also provide a Category I precision landing capability to nearly any point in the world. From a technical viewpoint, these capabilities appear to be achievable. It remains to be seen whether political and operational realities will allow the full technical capabilities of GPS to be available to civil aviation.

#### 5.6.2.3 Microwave Landing System (MLS)

MLS was designed as an approach and landing aid, but with its broad area coverage ( $\pm 40$  degrees and  $\pm 60$  degrees), combined with an RNAV capability, it offers the potential for a highly accurate navigation system within the TEC environment.

#### 5.6.2.4 Very High Frequency Omni-directional Radio Range/Distance Measuring Equipment (VOR/DME)

Normally, VOR/DME coverage is adequate in most terminal areas; however, coverage may be somewhat limited in outlying en route areas. Remote locations which do not have terminal activity face the possibility of not having VOR/DME coverage. The operational parameters of VOR/DME do not offer reception below line-of-sight. Since the normal operating strata of helicopters includes remote and low altitude areas, it is doubtful that adequate navigational support can be effectively derived from this system because of terrain and obstructions.

#### 5.6.2.5 Nondirectional Radio Beacon (NDB)

NDBs transmit a low or medium frequency signal whereby pilots can determine their bearing from the station and "home" on the station. This is a low cost system that provides a certified navigational means for both approach and en route navigation. These facilities actively support primary and backup airway route systems throughout the conterminous United States and Alaska.

Erratic response to atmospheric disturbances occasionally results in erroneous navigational information and a less than desirable condition for en route navigation over extended distances. NDBs are used widely as a means to locate and identify the marker beacon for precision approaches, and require significant pilot workload.

Note: They also suffer from a lack of available frequencies in high use areas.

#### 5.6.3 Surveillance

There is a definite shortage of surveillance coverage in the en route environment at the operating altitudes preferred by helicopters, as evidenced by operations in the Gulf of Mexico. Generally, surveillance coverage in terminal airspace is adequate, and it is available to provide service to surrounding heliports in addition to the major airport.

While surveillance is not essential to air traffic control in low density traffic areas, delays associated with the lack of it can make IFR operations impractical for both operator and controller. Essentially,

the most meaningful and productive air traffic services are provided only where radar coverage is available. In this regard, the helicopter community is a long way from receiving essential air traffic services and consequently has been thwarted in its attempt to break into the IFR environment.

#### 5.6.3.1 Radar

Radar is the backbone of the current ATC system and is available in virtually all congested terminal areas and along current IFR routes. However, since radar is limited to altitudes above line-of-sight, there is a lack of coverage in many areas where helicopters fly because of their low operating altitudes. In addition, radar surveillance is an expensive alternative, since both primary and secondary radar systems are costly.

#### 5.6.3.2 Automatic Dependent Surveillance (ADS)

The FAA's Capital Investment Plan (CIP) addresses new projects, one of which is ADS. ADS is a research and development (R&D) project intended to enhance aviation safety and efficiency in airspace that is currently beyond radar coverage. Oceanic airspace is expected to receive initial implementation of ADS. It will allow air traffic controllers to monitor flight paths to ensure that route deviations are recognized and corrected prior to aircraft confliction. An aircraft's position data, derived from GPS, will be relayed to the air route traffic control center (ARTCC) through a satellite data link network, where it will ultimately be displayed on the controller's radar scope and possibly result in reductions in separation minima and increased accommodation of user-preferred routes and trajectories. There are, however, questions as to the suitability of ADS for small aircraft. Weight penalties for the necessary antenna, aircraft avionics, and associated cabling currently can exceed 155 pounds, equivalent to the loss of a passenger seat. This cost penalty probably means that helicopters are unlikely to become involved in a true ADS operation without further technology developments to reduce weight and cost. Conceptually, it is possible to employ ADS concepts using ground-based communication facilities. This approach may be more feasible for helicopter operations.

Conceptually, ADS is the same as LORAN-C offshore flight following (LOFF); however, the communications data link for LOFF is ground-based rather than satellite-based as it is for ADS and the position function is provided by LORAN-C rather than GPS.

#### 5.6.3.3 LORAN-C Offshore Flight Following (LOFF)

LOFF is a variation of an ADS system, described in the CIP as an automatic independent surveillance system. LOFF utilizes LORAN-C derived aircraft position in latitude and longitude, sends the information to a transceiver, and transmits it via data burst on very high frequency (VHF) to the ATC computer. The data is converted into a standard common digitizer format, providing pseudo beacon reply messages to the computer and finally displaying track and data on the controller's display. It was tested in Houston ARTCC utilizing helicopters that operate in the Gulf of Mexico. If the system becomes operational, it appears to be

capable of providing surveillance coverage throughout appropriate areas of the Gulf.

Although tests indicate that displayed aircraft positions differ slightly from radar correlated positions, the differences are quite small and affect all participating aircraft in a similar manner. LOFF has the potential to provide tracking and separation services in areas where radar is not available.

Simulation and testing of the LOFF program indicate that although its repeatable accuracy may not meet radar accuracy requirements, the system performs consistently and targets located in close proximity to each other are displayed in the appropriate positions relative to each other. Even if LOFF does not provide the accuracy of radar, tests indicate that it is accurate enough to permit its use by air traffic control in providing aircraft separation services.

In en route environments utilizing the en route automated radar tracking system (EARTS), radar separation is considered to be 5 miles. Nonradar in-trail separation is specified as 20 miles between aircraft using DME and/or RNAV, or 10 minutes between other aircraft.

While LOFF may never meet the 5-mile standard possible with radar, it appears to have the potential to safely permit the use of 10-mile separation under most circumstances. Ten mile separation could roughly double the IFR capacity of today's Gulf operations.

#### 5.6.4 Weather

Surface weather observations, including current altimeter settings, are required for instrument approaches and can assist in flight under visual rules. While surface weather observations are available at large FAA facilities most of the time and at smaller, part-time (day/evening) FAA facilities some of the time, remote operating locations generally do not possess this capability. Installation of an automated weather observing system (AWOS)/automated surface observing system (ASOS) would fill this potential gap.

#### 5.6.5 Facility Control Positions

The number of control positions required in an ARTCC will probably not be affected by number of helicopter operations, since they control relatively few IFR helicopters. In the event that there should be a significant increase in IFR helicopter operations, the increase would probably be more noticeable in TEC or in a system similar to the existing Northeast Corridor, both of which have been established in approach control airspace. This could eventually lead to a requirement to establish additional operating positions at terminal radar approach control facilities (TRACONS) to handle tower en route traffic during busy periods or at those facilities that control numerous IFR helicopters.

## LIST OF REFERENCES

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7100.9A.....	Standard Terminal Arrival (STAR)
7110.10I.....	Flight Services
7110.22.....	Arrival and Departure Handling of High Performance Aircraft
7110.65F.....	Air Traffic Control
7110.79C.....	Chartered Visual Flight Procedures
7110.83B.....	Oceanic Air Traffic Control
7110.91.....	Tower En Route Control
7110.97.....	Airport Operating Practices
7110.98.....	Simultaneous Converging Instrument Approaches (SCIA)
7110.102.....	Air Traffic LORAN-C Approach Procedures
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7220.2.....	Operational Position Standards
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8260.3B.....	United States Standard for Terminal Instrument Procedures (TERPS)
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AC 61-13B.....	Basic Helicopter Handbook
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# LIST OF ACRONYMS

ADS	Automatic Dependent Surveillance
AFB	Air Force Base
AGL	Above Ground Level
ARTCC	Air Route Traffic Control Center
ASOS	Automated Surface Observing System
ATC	Air Traffic Control
ATD	Air Traffic Division
ASOS	Automated Surface Observing System
AWOS	Automated Weather Observing System
CIP	Capital Investment Plan
CNS	Communication, Navigation, and Surveillance
CTR	Civil Tiltrotor
CVFP	Charted Visual Flight Procedure
DME	Distance Measuring Equipment
EARTS	En route Automated Radar Tracking System
EMS	Emergency Medical Service
FAA	Federal Aviation Administration
FIFO	Flight Inspection Field Office
FSDO	Flight Standards District Office
GADO	General Aviation District Office
GPS	Global Positioning System
HAI	Helicopter Association International
HVAP	Helicopter Visual Approach Program
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
LOA	Letter Of Agreement
LOFF	LORAN-C Offshore Flight Following
LORAN-C	Long-Range Navigation
MAP	Missed Approach Point
MEA	Minimum En route Altitude
MLS	Microwave Landing System
MSL	Means Sea Level
NAR	National Airspace Review
NAS	National Airspace System
NDB	Non-Directional Beacon
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
RCF	Remote Communication Facility
R&D	Research and Development
RNAV	Area Navigation
RMP	Rotorcraft Master Plan
SID	Standard Instrument Departure
STAR	Standard Terminal Arrival
SVFR	Special Visual Flight Rules
TCA	Terminal Control Area
TCAS	Traffic Alert and Collision Avoidance System
TEC	Tower En route Control
TRACON	Terminal Radar Approach Control Facility
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omnidirectional Range
VTOL	Vertical Takeoff and Landing